Note

An Econometric Analysis of the Chinese Economy

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Summary

Recently the model with expectation has become to play the important role in the actual econometric analyses. Especially, monetary crisis attacking East Asian countries showed us that the expectation or forecasts on the exchange rate and asset market decisively affected the real economy of these nations and the world. It is desirable if we are able to involve the forward looking expectations explicitly in the model. The model presented here is developed to provide a structural framework mainly to analyze the impact of policy changes on other countries through a simple open-macro model. The model can differ from the conventional macroeconometric models in terms of the expectation, trade relation and the treatment of capital flows. Through this characteristics, we examined the new structural equations with forward-looking variables to test the difference between the shocks without knowing the policy change in advance and with some knowledge about it.

Keywords: forward-looking model, Asian Link, bilateral trade, rational expectation, capital flow

1. Introduction

Macroeconometric modeling still remains the most powerful tool to understanding the macroeconomic structures and relations between countries. The model presented here is developed to provide a structural framework mainly to analyze the impact of policy changes on other countries through a simple open-macro model. The model can differ from the conventional econometric models in terms of the expectation, trade relations and the treatment of capital flows.

Recently the model with expectation has become to play the important role in the actual econometric analyses. Especially, monetary crisis attacking East Asian countries showed us that the expectation or forecasts on the exchange rate and the asset market decisively affected the real economy of these nations and the world. It is desirable if we are able to involve the forward looking expectations explicitly in the model. So far very few econometric models like IMF's MULTIMOD and Asian LINK model by ESRI(Japan) can be referred in the practical use.

The Chinese model developed here is a part of East Asian Link Model, which consists of 11 countries including Japan and The United States. As many researchers have mentioned, recent development of China has become to lead her to the giant motive power of the world economy, and it affects not only on the world economic structures but also on the trade relations. China has accelerated to develop with taking the opportunity to joining in WTO as the world manufacturing center, and today, has changed to become one of the largest domestic market in the world. The rapid growth has been partly sustained by the rapid growth in the capital formation including FDI. This not only made the presence of China bigger, but also changed the trade pattern between capital exporters such as Japan, Korea and Taiwan and China. through the tight relations of supply chains. This requires the model to have the bi-lateral trade functions.

In this paper, we examine the new structural equations with forward-looking variables to test the difference between the shocks without knowing the policy change in advance and with some knowledge about it.

2. Brief overview on the model with forward-looking variables

(1) The adaptive expectation

The theoretical model is as following, here, y and x denote the endogenous and exogenous variables respectively, u denotes the error term and suffix e means expectation.

$$y_t = \alpha + \beta x^e_{t+1} + u_t$$
$$x^e_{t+1} = \sum_{i=0}^{\infty} \beta_i x_{t-1}$$
$$\text{where, } \beta_i = \beta_0 \lambda^i, \ 0 < \lambda < 1$$

Then, we have the following adjusting process.

$$x^e_{t+1} = \sum (1-\lambda) \lambda^i x_{t-1}$$
$$x^e_{t+1} - x^e_t = (1-\lambda)(x_{t+1} - x^e_t)$$

We can denote the unobservable expectation as the set of known variables.

$$\begin{aligned} y_t - \lambda y_{t-1} &= \alpha(1-\lambda) + \beta(x^e_{t+1} - \lambda x^e_t) + u_t - \lambda u_{t-1} \\ &= \alpha(1-\lambda) + \beta(1-\lambda) x_t + \upsilon_t \end{aligned}$$

This is equivalent to the conventional auto-regressive model,

$$y_t = \alpha' + \beta' x_t + \gamma' y_{t-1} + \upsilon_t$$
$$\upsilon_t = u_t - \lambda u_{t-1}$$

(2) The forward looking expectation

The model is modified and will be written as

$$y_t=\beta y^*_{t+1}+\gamma x_t+\eta_t$$
$$x_t=\rho x_{t-1}+\upsilon_t$$

Rationality is the key concepts to transform the "unknown expectation" to "known variables"
Note that individual subjective forecasts will converge to the mathematical expectation.

$$\begin{aligned}y^*_{t+1}&=E(y_{t+1}\mid I_{t-1})\\&=E(y^*_{t+1}\mid I_{t-1})\end{aligned}$$

Now,

$$y_{t+1}=\beta y^*_{t+2}+\gamma x_{t+1}+\eta_{t+1}$$

Then, we have the expectation with both sides of above equation.

$$Ey^*_{t+1}=\beta Ey^*_{t+2}+\gamma Ex_{t+1}+E\eta_{t+1}$$

Note that $E\eta_{t+1}=0$, then, the subjective expectation are written as

$$y^*_{t+1}=\beta y^*_{t+2}+\gamma x_{t+1}$$

Substitute this equation into the first equation, and iterating this procedure to the next forward period, we will finally obtain the following equation.

$$y_t=\beta^n y^*_{t+n}+\gamma\beta^{n-1}x^*_{t+n-1}+\cdots+\gamma\beta x^{t+1}+\gamma x_t+\eta_t$$

Note $\beta^n\to 0$, $n\to\infty$ and $x^*_{t+1}=\rho x^*_t=\rho^2 x_{t-1}$, then

$$\begin{aligned}y_t&=\gamma(\beta^{n-1}x^*_{t+n-1}+\cdots+\gamma\beta x^*_{t+1})+\gamma x_t+\eta_t\\&=\frac{\gamma\rho^2\beta}{1-\rho\beta}x_{t-1}+\gamma x_t+\eta_t\end{aligned}$$

Therefore, the original equation can be rewritten by the combination of equations which do not include forward looking variables.

This simple expression of the expectation is quoted from Ban(1991). However, of course, this kind of completely solvable expectation such as the Ban's example would seldom arise, and we usually substitute the expectation y^*_{t+1} to the actual y_{t+1}.

(3) A famous example of the model with expectations at work (MULTIMOD by IMF)

$$C_t = C_{DI,\,t} + C_{PI,\,t}$$
$$C_{DI,\,t} = \alpha YD_t$$
$$C_{PI,\,t} = \theta(HW_t + FW_t)$$
$$FW_t = M_t + V_t + B_t + NFA_t$$
$$HW_t = YD_t + \frac{1}{1 + r_t + \rho} HW_{t+1}$$

C_{DI} : consumption by present income
C_{PI} : consumption by permanent income
YD: disposable income
HW : human wealth
FW : financial wealth
M: money supply
V : corporate market value
B: bonds
NFA : net foreign asset
r : rate of interest

(4) The estimation method with expectations

Hansen (1982) proposed Generalized Method of Moments (GMM) to estimate parameters with serially correlated error terms consistently and more efficiently. If the model contains forward looking variables and cannot be solved explicitly, this procedure is preferable to other methods like OLS.
The model is as follows;

$$y = X\beta + u$$

Multiply the instrumental variable Z from the left-hand side to avoid serial correlation in the error term.

$$Z'y = Z'X\beta + Z'u$$

If u is not auto-correlated and constant in deviation, then we can apply GLS

$$\beta_{INST} = (X'ZV^{-1}Z')^{-1}X'ZV^{-1}Z'y$$

However,β_{INST} is not efficient, if $E(Z7uu'Z) \neq \sigma^2 Z'Z$. Then, first calculate

$$e = y - 1X\beta_{INST}$$

$$V = Z'ee'Z$$
$$\beta_{GMM} = (X'ZV^{-1}Z'X)^{-1}X'ZV^{-1}Z'y$$

To calculate non-singular V matrix, there are several kind of weight matrices, called "Kernel".

(5) The simulation method : the Fair-Taylor algorithm

The model is written implicitly in general as

$$f(y_t, y_{t+1}, \cdots, y_{t+p}, E(y_{t+1}), \cdots, E(y_{t+h}), X_t, \alpha) = u_t$$
$$u_t = \rho u_{t-1} + \varepsilon_t$$

where y_t is an n-dimensional vector of endogenous variables, x_t is a vector of exogenous variables, E_{t-1} is the conditional expectations operator based on the model and on information, α_i is a vector of parameters, ρ_i is the serial correlation coefficient for the error term u_{it}, andε_{it} is an error. The function *f* may be nonlinear in variables, parameters, and expectations. The following is a brief review of the solution method for this model. More detailed discussions are shown in Fair(1984)(1994)

The Fair-Taylor method iterates over expectations through period s + h + k + h solution paths which are free from terminal conditions.

1) solving the model for period (s).
2) model has maximum lead time (h)
   so, we need conventional simulation for period (s+h)------ TYPE (1)
3) substitute the value of expectation with the solution above,
   and simulate again ----- TYPE(2)
4) expand the simulation period, length=(k),
   which is enough longer not to affect the solution at s+h
   -----> to satisfy the terminal conditions ----- TYPE(3)
5) at the end period s+h+k, we again need the maximum lead (h).
   After all, the final period of this procedure will be s+h+k+h.

Recently, MULTIMOD(IMF) has applied the Newton-Raphson based method, that is one of 'Time Stacking' methods called L-B-J, which was developed by Julliard and others (1998). The new method is apparently faster and well converging.

3. The New Asian Link Model

As mentioned above, the model consists of 11 countries and has bilateral trade equations, that is, each of 11 countries has basically 11 exporting functions. Each country model has about 50 equations including both of trade functions and identities.

Firstly, we state about the notational rules.

the notation GDP...real GDP,
GDPV...nominal GDP, V attached means 'nominal' for all variables.
GDP$...denoted by US$
GDP(-1)...1 year lag
GDP(+1)...1 year lead (the forward looking variable)
C(1), C(2)...coefficients

countries CH...China HK...Hong Kong IN...Indonesia JP...Japan
KR...Korea ML...Malaysia PH...Philippines SG...Singapore
TH...Thailand TW...Taiwan US...United States
WD...World RW...Rest of the world
XX...bilateral Trade(e.g. XX_CHJP)

(1) The DGP definition

GDP=C+IF+GC+X-M
GDPV=CV+IFV+GCV+XV-MV
C...consumption. CV is the nominal consumption and so forth.
IF...gross capital formation(usually including governmental investment)
GC...governmental consumption
X...export of goods and services
M...import of goods and services

(2) The Consumption

The model is basically based on the permanent income hypothesis. The discounted value of future wealth can affect the present consumption. This equation contains the forward looking variable concerning future wealth W.

$$W_t = (1 - taxrate)\frac{Yd_t}{PC_1} + \left(\frac{1}{1 + dirate}\right)W_{t+1}$$

$$C_t = c_0 + c_1\frac{Yd_t}{PC_1} + c_2 W_{t+1}$$

In actual model, we adopt the following specification.
C=C(11)+C(12)*PEDYV/PC*100+C(13)*(1/(1+RLG(+1)/100))
*DPRIV(+1)/PC(+1)*100
PEDYV....disposable income(household)
DPRIV.... total deposits, a proxy for the wealth
PC....deflator for the consumption
RLG....long term interest rate, a proxy for the discount rate

(3) The Disposable Income

The disposable income is directly linked to the nominal GDP. Though the data are not available, here we use the OEF estimate, basically calculated from average wage multiplied number of workers. We add overall tax rate here.

PEDYV=C(1)+C(2)*(1-TAXRATE)*GDPV +C(3)*PEDYV(-1)

TAXRATE....income tax, corporate tax and indirect tax(if any) divided by GDPV

some country only includes the income tax.

(4) The Fixed Investment

Investment functions are largely different from those of the conventional models. We neither adopt the stock adjusting model nor the Jorgenson model (Neoclassical model). Most countries depending on the foreign capital and aid have the tendency that investments grow in parallel to the inflow of the capital such as FDI. For example, the percent of foreign capital in the investment goes beyond almost 30-40% in Singapore.

IF=C(1)+C(2)*GDP+C(3)*(NFDI$+FDI$)*RXD/PIF*100+C(5)*RLG(+1)

FDI$....foreign direct investment(mainly inflow, in US$)

NFDI$....inflow except FDI

RXD....exchange rate (RMB/$)

PIF....deflator for the fixed investment

This specification is still tentative. In the case of Asian monetary crisis, RXD has rapidly depreciated and this caused rapid increase in foreign debt in local currency unit and the same time, increase in capital cost.

To denote this, we can add some risk premium proxy like (NFDI$+FDI$)*RXD/GDPV to the equation.

This specification has no application to some countries especially to the developed countries. For this case, the following specification is also adopted.

IF/K(-1)=C(1)+C(2)*(GDP-X+M)/K(-1)+C(3)*IF(-1)/K(-1)

K=C(4)+C(5)*K(-1)+C(6)*IF

K.....Capital stock, the estimate by OEF, accumulated real investment using constant capital

consumption rate such as 5-10%.

(5) The Export

In this model, bilateral trade function has the fundamentally important role. Export from country (i) to (j), that is, XX_{ij} is explained by the demanding country's GDP and the relative price

The horizontal summation provides the total export of China, the vertical summation does for the total import. As these relations stand for the nominal trade, the export price and the import price should be consistently determined.

		China		Japan		Total
		::				
China	・・・	-	・・・	XX_CHJP	・・・	X(export)
		::				
Japan		XX_JPCH		-		
		::				
Total		M(Import)				

LOG(XX_CHJP$)=C(11)+C(12)*LOG(JP_GDP)+C(13)
*LOG(CH_PX$/JP_PM$)+C(14)*LOG(XX_CHJP$(-1))

These equation typicaly counts up to 10x10. The sign condition of parameter GDP is expected to be plus and minus for the relative price.

XX_CHWD$=1.0*(XX_CHHK$+XX_CHIN$+XX_CHJP$+XX_CHKR$
+XX_CHML$+XX_CHPH$+XX_CHSG$+XX_CHTH$+XX_CHTW$
+XX_CHUS$+XX_CHRW$)

X$=C(1)+C(2)*XX_CHWD$+C(3)*X$(-1)

X$V=X$*PX$/100

XV=X$V*RXD

X=XV/PX*100

RXD....exchange rate

(6) The Import

The import of China is the simple sum of the exports from each country to China, for example.

XX_WDCH$=1.0*(XX_HKCH$+XX_INCH$+XX_JPCH$+XX_KRCH$
+XX_MLCH$+XX_PHCH$+XX_SGCH$+XX_THCH$+XX_TWCH$+XX_
USCH$+XX_RWCH$)

M$=C(1)+C(2)*XX_WDCH$+C(3)*M$(-1)

M$V=M$*PM$/100

MV=M$V*RXD

M=MV/PM*100

(7) Reserves

The foreign currency reserve position can affect the changes in the money supply unless it's not sterilized. In the developed country such as the United States, changes in reserves are fully cancelled out by adjusting the amount of governmental debt. However, situation is not true for many countries. For example, Yuan-selling intervention will increase the same amount of monetary base in the domestic market if not sterilized. In some developing country, this may cause the hyper inflation.

RES$=RES$(-1)+BCU$+BCAP$+RESPOS$

RES$....reserve

BCU$....trade balance

BCAP$....capital account

RESPOS$....reserve position(currently set zero)

(8) The Balance of payment

BCU$=X$V − M$V

BCAP$=FDI$ + NFDI$

FDI$....foreign direct investment(mainly inflow)

NFDI$....non FDI capital inflow

(9) The Interest Rate

In this model various interest rates are arranged into two typical rates, that is, long term interest rate beyond typically 6 months and short term interest rate within 1 month. We use the L-M framework to determine the short term interest rate, therefore, it's a function of real GDP and money supply denominated by GDP deflator.

RSH=C(1)+C(2)*(MON2/PGDP)+C(3)*GDP

RSH....short term interest rate

MON2....money supply(stock)

PGDP....GDP deflator

Whereas, the long term interest rate is assumed to be the function of the expectation of the short term interest rate and increase in total debt.

RLG=C(1)+C(2)*RSH(+1)+C(3)*(DBT/DBT(-1)-1)*100

RLG....long term interest rate

DBT....total debt (governmental debt for some country)

(10) The Money Supply

As stated above, changes in money supply depend on mainly independent monetary policy and also on the changes in reserves and debts.

MON2=C(1)+C(2)*(1-delta)*(RES$*RXD + C(3)*DBT) + POLICY

POLICY....monetary policy variable currently set zero.

delta....ratio on sterilization, if=1, money supply is independent of reserves.

(11) Prices

There are several price indices like Import price index, Export price index and deflators.

At first, we assume the export price in local currency does not differ according to the partner countries, and is treated as exogenous. Of course, export price in $ should vary by the changes in the exchange rate. Meanwhile, import price is determined by the exporting price of trading partner countries, that is, the weighted average of PX$ of each exporting country.

PX$=PX/RXD

PX....export price index(local currency unit)

PM....import price index(local currency unit)

$....denoted in US$

RXD....exchange rate (RMB/$)

LOG(PM/RXD)=C(1)+C(2)*((XX_HKCH$*LOG(HK_PX$)
+XX_INCH$*LOG(IN_PX$)+XX_JPCH$*LOG(JP_PX$)+XX_KRCH$
*LOG(KR_PX$)+XX_MLCH$*LOG(ML_PX$)+XX_PHCH$
*LOG(PH_PX$)+XX_SGCH$*LOG(SG_PX$)+XX_THCH$
*LOG(TH_PX$)+XX_TWCH$*LOG(TW_PX$)+XX_USCH$
*LOG(US_PX$)+XX_RWCH$*LOG(RW_P$))/(XX_WDCH$))
+C(3)*LOG(PM(-1)/RXD(-1))

XXij$....bilateral trade between (i) and (j) country

PM$=PM/RXD

Secondly, we adopt the following brief specification for deflators for the consumption and the fixed investment.

LOG(PC)=C(11)+C(12)*LOG(ER)+C(13)*LOG(PM)

LOG(PIF)=C(21)+C(22)*LOG(ER)+C(23)*LOG(PM)

PC....deflator for the consumption

PIF....deflator for the fixed investment

ER....average earnings estimated by OEF

PM....import price index

(12) The Labor and the Unemployment

LOG(ET)=C(1)+C(2)*LOG(GDP)

ET....employment

U=LS - ET

LS....work force

U....unemployment

UP=U/LS*100

UP....unemployment rate

(13) The Wage

LOG(ER)=C(1)+C(2)*LOG(PGDP)+C(3)*LOG(ER(-1))

(14) Nominal-Real conversion

CV=C*PC/100

IFV=IF*PIF/100

GCV=GC*PGC/100

PGDP=GDPV/GDP*100 (implicit deflator)

4. The brief presentation of the estimated parameters (results selected)

Consumption

Equation:CH_C=C(11)+C(12)*CH_PEDYV/CH_PC*100+C(13)*(1/(1+CH_RLG(+1)/100))
*CH_DPRIV(+1)/CH_PC(+1)*10

	C(1)	C(2)		C(3)		R2(adj)
China	62.4	0.61756	(33)	0.032	(3.05)	0.985
Taiwan	325068.8	0.42449	(3.49)	155.9	(3.26)	0.990
Korea	-7772.6	0.7158	(9.73)	78.7	(1.84)	0.972
Hong Kong	-177890.4	0.93155	(19.9)	43.6	(3.78)	0.955
Singapore	18.8	0.83351	(1001.4)			0.999
Thailand	32.9	0.75619	(11)	0.072	(1.82)	0.991
Indonesia	-12212.4	0.40741	(6.2)	0.859	(25.3)	0.967

Disposable Income

Equation:CH_PEDYV=C(1)+C(2)*(1-CH_TAXRATE)*CH_GDPV+C(3)*CH_PEDYV(-1)

	C(1)	C(2)		C(3)		R2(adj)
China	-2.882703	0.516561	(3.62)	0.380493	(1.95)	0.993
Taiwan	-42549.13	0.325022	(14)	0.653191	(23.8)	0.999
Korea	5171.726	0.455064	(3.24)	0.484681	(2.73)	0.997
Hong Kong	47144.17	0.663361	(5.27)	0.111759	(0.69)	0.993
Singapore	2877.719	0.423035	(4.68)	0.236014	(1.41)	0.994
Thailand	139.324	0.425453	(12.7)	0.348217	(6.56)	0.999
Indonesia	13805.82	0.5427	(6.91)	0.441833	(4.14)	0.994

Gross Fixed Investment(type1)

Equation:CH_IF=C(1)+C(2)*CH_GDP+C(3)*(CH_NFDI$+CH_FDI$)
*CH_RXD/CH_PIF*100+C(4)*CH_RLG(+1)

	C(1)	C(2)		C(3)		C(4)		R2(adj)
China	120.6035	0.352807	(19.8)	0.000661	(3.83)	-26.5	(-2.89)	0.989
Taiwan	-476377.2	0.27658	(22.8)	-0.000266	(-0.01)**	11594.9	(0.37)**	
Korea	-83150.11	0.390516	(24.2)	0.000637	(2.98)	4462.6	(4.71)**	0.948
Hong Kong	-267282.9	0.429411	(8.26)	-58.11294	(-1.39)**	18183.2	(2.85)**	0.842
Singapore	-10677.27	0.359858	(10.2)	-0.129084	(-2.53)**	2407.5	(3.32)**	0.943
Thailand	-677.1506	0.346208	(22.1)	0.000323	(5.31)	65.7	(11.40)**	0.945
	29.4541	0.284671	(9.08)	0.000813	(8.63)			0.740
Indonesia	-44048.77	0.323281	(19.7)	0.000703	(10.2)	1354.6	(6.08)**	0.939
	-18917.27	0.311533	(13.6)	0.000623	(13.7)			0.875

Gross Fixed Investment(type2)

Equation:TW_IF/TW_K(-1)=C(1)+C(2)*(TW_GDP-TW_X+TW_M)/TW_K(-1)+C(3)
*TW_IF(-1)/TW_K(-1)/TW_K(-1)+C(3)*TW_IF(-1)/TW_K(-1)

	C(1)	C(2)		C(3)		R2(adj)
China	-0.036967	0.119906	(1.60)*	0.917915	(7.27)	0.886
Taiwan	-0.052192	0.221911	(5.26)	0.318544	(2.4)	0.913
Korea	-0.088995	0.316199	(10.4)	0.469903	(7.5)	0.972
Hong Kong	-0.017231	0.149927	(4.03)	0.552233	(4.15)	0.761
Singapore	-0.116558	0.263517	(6.32)	0.869091	(7.96)	0.908
Thailand	-0.018574	0.0826	(1.78)*	0.814784	(4.22)	0.961
Indonesia	0.016692	0.092241	(2.01)	0.592332	(2.44)	0.783

(**) unacceptable sign conditions

ExportofGoods;BilateralTrade

Equation:LOG(XX_CHHK$)=C(11)+C(12)*LOG(HK_GDP)+C(13)
*LOG(CH_PX$/HK_PM$)+C(14)*LOG(XX_CHHK$(-1))

		Income		Relative Price		Lag term		R2(adj)
China →	Hong Kong	1.1254	(-2.29)	-1.0000	given	0.3919	(1.77)	0.883
	Indonesia	1.5206	(2.42)	-0.8312	(-2.54)	0.5214	(3.34)	0.963
	Japan	0.308	(0.51)	-0.5303	(-1.19)	0.9743	(9.52)	0.971
	Malaysia	0.7446	(1.64)	-1.4663	(-1.24)	0.7543	(3.84)	0.971
	Philippines	0.9622	(1.26)	-1.9431	(-2.40)	0.4678	(2.57)	0.907
	Singapore	0.6665	(3.24)	-3.2817	(-3.23)	0.9779	(4.86)	0.908
	Thailand	1.5672	(2.01)	-1.02	(-0.29)	0.2836	(0.84)	0.852
	USA	1.2474	(0.82)	-1.1963	(-0.75)	0.8928	(3.91)	0.972
	Korea	3.3245	(12.4)	-0.969	(-1.74)	0.0538	(0.9)	0.988
	Taiwan	2.2894	(1.69)	-1.0000	given	0.4242	(1.6)	0.961

Import Price

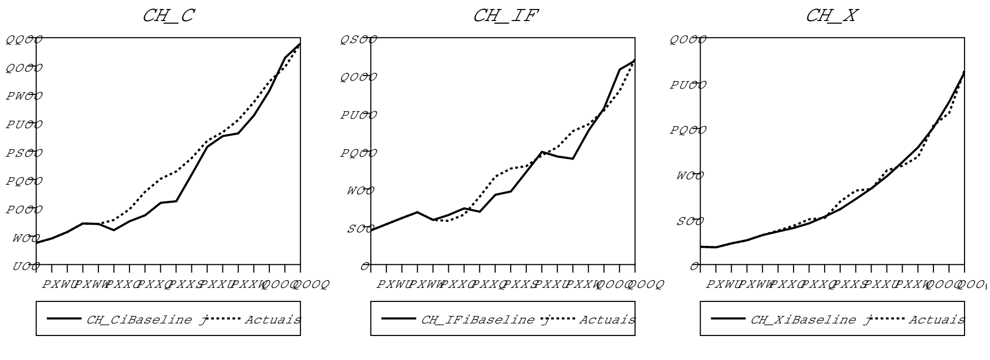
Equation:LOG(CH_PM/CH_RXD)=C(21)+C(24)*((XX_HKCH$*LOG(HK_PX$)
+XX_INCH$*LOG(IN_PX$)+XX_JPCH$*LOG(JP_PX$)+XX_KRCH$
*LOG(KR_PX$)+XX_MLCH$*LOG(ML_PX$)+XX_PHCH$
*LOG(PH_PX$)+XX_SGCH$*LOG(SG_PX$)+XX_THCH$
*LOG(TH_PX$)+XX_TWCH$*LOG(TW_PX$)+XX_USCH$
*LOG(US_PX$)+XX_RWCH$*LOG(RW_P$))/(XX_WDCH$))
+C(25)*LOG(CH_PM(-1)/CH_RXD(-1))

	C(21)	C(24)		C(25)		R2(adj)
China	0.65098	0.53843	(10.2)	0.32065	(4.78)	0.967
Taiwan	0.22549	0.44182	(3.13)	0.51115	(4.11)	0.804
Korea	-0.15311	0.58288	(2.44)	0.45115	(2.01)	0.603
Hong Kong	0.06261	0.46997	(8.88)	0.51921	(10.8)	0.979
Singapore	0.01660	0.41398	(2.19)	0.58482	(3.18)	0.622
Thailand	-0.34433	0.42751	(3.49)	0.65011	(8.98)	0.939
Indonesia	-0.09250	0.68810	(1.74)	0.33689	(1.47)	0.981

5. The Simulation Analysis

(1) Model Accuracy

Usually accuracy of the model is tested through the final test with forward looking



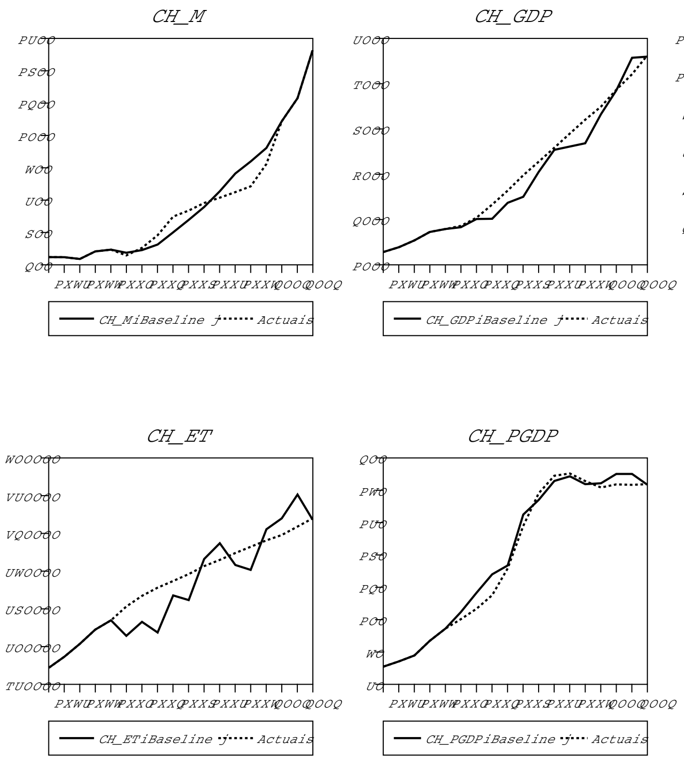


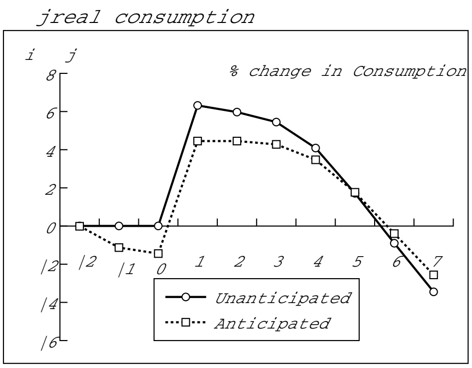
Figure 1. the final test for selected variables

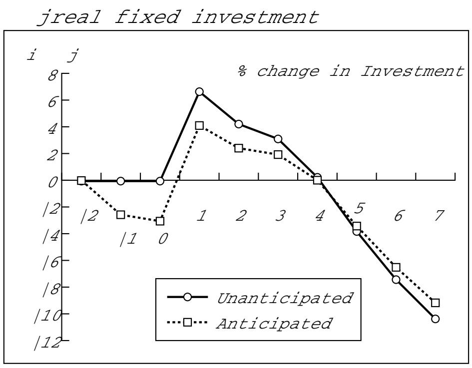
variables.

The results for several endogenous variables are shown above. For example, the actual value of capital formation (CH_IF) and GDP (CH_GDP) are well tracked, and residuals of all variables remain fairly small.

(2) Policy Simulation

If RMB would be appreciated by 10%, how the impact on the main variables appear? For this time, we carried out in 2 ways, one is an Unanticipated simulation, which is the conventional case, and it is assumed that no one knows the timing and the dimension of





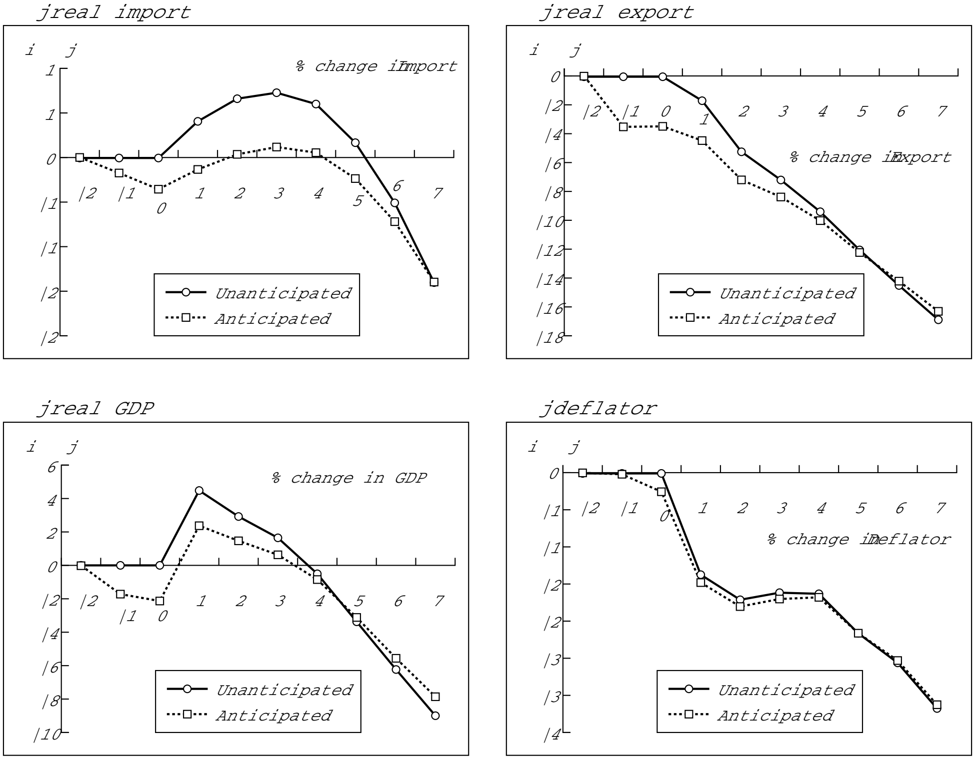


Figure 2. The comparison of Unanticipated and Anticipated case

the policy change in advance. On the contrary, if we can anticipate the policy change, we should correspond to it before it will occur actually. This is an Anticipated case and this type of simulation can be curried out by using the model with forward looking variables. The result shows that the policy effects in the case of the anticipation are depressed to almost 2/3 level compared to the unanticipated case for the most variables. At the same time, these variables have the tendenncy not to comverge within 10 years.

References

Ban, Kanemi 1991, *Macroeconometric Analysis* (in Japanese), Yuhikaku

ESRI, 2002, 'An East Asian Macroeconometric LINK Model,' *Economic Analysis* No164 Economics and Social Research Institute, Cabinet Office, Japan

Fair, R. C., 1984, *Specification, Estimation, and Analysis of Macroeconometric Models* Harvard University Press

Fair, R. C., 1994, *Testing Macroeconometric Models*, Harvard University Press

Julliard M, D.Laxton et. al., 1998, 'An Algorithm Competition: First Order Iterations vs. Newton Based Techniques,' *Journal of Economic Dynamics and Control*, 22

Maddala, G. S., 1992, *Introduction to Econometrics*, Prentice Hall, Inc

Ozaki, Taiyo, 1999, *World Macroeconometric Analysis* (in Japanese) Koyoshobo, Kyoto, Japan

Taylor, John B. 1993, Macroeconomic Policy in a *World Economy*, W.W.Norton Co